

International Nuclear Energy Research Initiative

U.S. DEPARTMENT OF ENERGY INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE United States/Japan

ABSTRACT

Preliminary Assessment of Irradiation Performance of Zirconium Carbide (ZrC) TRISO Fuel Particles

Principle Investigator (U.S.): Y. Katoh and L. Snead
Oak Ridge National Laboratory

Project Number: 2006-001-J

Principal Investigator (Japan): K. Sawa and S. Ueta
Japan Atomic Energy Agency (JAEA)

Project Start Date: March 2006

Collaborators: Idaho National Laboratory

Project End Date: February 2009

Project Abstract

Zirconium carbide (ZrC) is a leading candidate for replacing silicon carbide (SiC) as a coating material in TRISO fuel particles. However, the fundamental radiation effects of ZrC are unknown and must be determined in order to assess its viability as a fuel coating. Japan initiated a large-scale ZrC TRISO fuel particle development effort in late 2004 and has partnered with ORNL and INL through I-NERI to perform a neutron irradiation effects study. This project is intended to 1) clarify the fundamental irradiation response of ZrC, both in the form of a coating on surrogate TRISO particles and in a zone-refined, high-purity, polycrystalline form; 2) evaluate statistical fracture strength properties of developmental ZrC coatings before and after irradiation; and 3) develop a failure model of ZrC TRISO particles for fuel performance evaluation and safety design.

This project consists of the following tasks, which will be shared among the three laboratories:

1. Conduct post-irradiation examination (PIE) of zone-refined, high-purity ZrC samples presently being irradiated at ORNL to understand baseline irradiation effects
 2. Characterize mechanical properties of unirradiated developmental ZrC coatings
 3. Perform high-temperature neutron irradiation of ZrC-TRISO coated surrogate fuel particles
 4. Conduct PIE of irradiated surrogate fuel coatings
 5. Use PARFUME model to study Zr-TRISO coated particle thermomechanical response
 6. Examine chemical interactions between ZrC and key fission products to identify potential degradation
 7. Irradiate fueled UO_2 -ZrC TRISO coated particles
-